

EVALUATION OF SCLERODERRIS CANKER
ON NATIONAL FOREST LAND IN THE
LAKES STATES - PLOT ESTABLISHMENT
AND PROGRESS REPORT - 1967

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EVALUATION OF SCLERODERRIS CANKER ON
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PLOT ESTABLISHMENT AND PROGRESS REPORT

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SUMMARY

More than half of the 2-10 year old red pine plantations examined in 1965 and 1966 on National Forest land in Upper Michigan and northern Wisconsin were infected by the pathogenic fungus Scleroderris lagerbergii Gremman. To determine the rate of spread of, and mortality caused by this fungus within infected plantations, 152 permanent spread plots were established in 31 plantations on the Nicolet and Chequamegon National Forests in Wisconsin and the Ottawa and Hiawatha National Forests in Upper Michigan in 1966. The plots will be re-examined annually for five years.

The results of the 1967 examination of the plots reveal an overall increase both in new infection and in mortality due to the pathogen. In the 7-10 year age group, an average of 5.3% more trees were infected than were the previous year. In the 4-6 year age group, an average of 1.7% more trees were infected. Of the mortality that occurred between the two examinations, 56% (or 1.1% of all trees on the plots) in the 7-10 year age group and 40% (or 1.5% of all the trees on the plots) in the 4-6 year age group was ascribed to S. lagerbergii. The increases do not appear serious, but the higher percentage of new infections in the older plantations suggests that damage may become more severe as the plantations get older. However, this conclusion is tentative until additional annual examinations can be completed.

INTRODUCTION

Of the 281 red pine plantations examined during the 1965 and 1966 surveys of 2-10 year old pine plantations on National Forest land in Upper Michigan and northern Wisconsin, more than half contained trees infected by the pathogenic fungus Scleroderris lagerbergii Gremman. To determine the rate of spread of, and mortality caused by this fungus within infected plantations, 152 permanent spread plots were established within 31 infected plantations on four National Forests - the Nicolet and Chequamegon in Wisconsin and the Ottawa and Hiawatha in Upper Michigan-during the summer of 1966. Plot establishment was in accord with a study plan of June 1, 1966 entitled, "Evaluation of Scleroderris Canker on National Forest Land in the Lake States", by Charles E. Cordell. This report describes the method of plot establishment and examination, summarizes the field data, and compares the results of the initial and the 1967 examinations.

OBJECTIVES

The objectives of this evaluation are: (1) to determine the annual rate of spread of S. lagerbergii within the infected red pine plantations on the four forests (2) to determine the annual rate of mortality caused by this pathogen within the infected plantations, and (3) to correlate the rates of disease spread and red pine mortality with age class.

METHODS AND PROCEDURES

Plantation selection: The original plan was to select the study plantations on the following basis:

1. Active S. lagerbergii present in 1965.
2. More than half of the original trees present.
3. Plantations divided into three age groups:
 - a. 1-3 year old
 - b. 4-6 year old
 - c. 7-10 year old
4. Choose four plantations in each age group per Forest.

However, the survey of 1-3 year old plantations was not completed in time to include this age group in the evaluation, and an insufficient number of acceptable plantations in the 7-10 year age group resulted in the following selections:

	Number of Plantations	
	<u>4-6</u>	<u>7-10</u>
Chequamegon N.F.	4	4
Nicolet N.F.	2	5
Ottawa N.F.	3	5
Hiawatha N.F.	4	4

Table

Approximate locations of the plantations selected are indicated on the map (Figure I).

unanswered question

Plot establishment: Square, one-twentieth acre plots were established within the chosen plantations in the following manner:

1. Five plots were established in each plantation, with the exception of three plantations on the Ottawa N.F. in which only four plots could be established.
2. The plots were spaced at least three chains apart and at least $2\frac{1}{2}$ chains from the plantation edge in an attempt to acquire a representative sample from each.
3. Each plot contained at least one tree infected with S. lagerbergii, but no plots were located where pine mortality had exceeded 50 per cent.
4. All plots were marked with corner stakes. Detailed maps were prepared to show plot location and each tree within it.

Plot examination: Plot data include location plot number and exposure (open or covered with brush, etc.). Annually for five years each tree is classified as to condition and symptom expression. Condition is recorded as follows:

1. Healthy - general condition and growth of tree is good.
2. Poor vigor - general condition and growth of tree is poor. However, tree is expected to survive through the next growing season.
3. Dying - general condition and growth of tree is poor. Symptoms pronounced. Tree is not expected to survive through the next growing season.
4. Dead - no evidence of tree growth, as expressed by live terminal, shoots, or needles.
5. Missing - no evidence of the tree in the vicinity of its probable planting location.

Symptom expression is recorded as follows:

1. Dead lateral branches - brown or red "flags".
2. Dead terminals - similar in color and condition to dead laterals except for a pronounced "needle droop" often encountered at the terminals.
3. Stem cankers - lesions or depressions that may be basal or formed anywhere along main or lateral stems.
4. Yellow-green discoloration - formed beneath the bark on portions of infected trees where S. lagerbergii is active.

In addition, damage from other causes, such as other diseases, insects, wildlife, and snow breakage is noted.

RESULTS AND DISCUSSION

The results of the initial and 1967 examinations of the spread plots are summarized in Tables I through V. Tables I through IV present information by Forest while Table V is a summary of all Forests by age group. Only spread of infection and mortality data are included in the present analysis.

The following terminology is used in the tables:

1. All percentages, except in the last column in Table V, are used as

"per cent of all the trees on the plots". The last column in Table V indicates the per cent of the seasons total mortality caused by S. lagerbergii.

2. An "infected" tree is defined as a tree showing the characteristic yellow-green discoloration of the wood inside bark at any point. Cankered or damaged trees without the discoloration were not considered infected.
3. The "dead or missing" columns indicate the per cent of trees dead or missing due to all causes. "Dying" trees, which were combined with dead on the survey reports, are omitted because many of those so classified during initial plot establishment subsequently recovered. The inclusion of "dying" trees confuses the analysis.
4. The "increase" figures represent 1967 additions to the initial 1966 readings.
5. The "total dead and discolored" columns indicate death of trees which may with reasonable certainty be ascribed to S. lagerbergii. Trees rather than percentages were used here to avoid obscuring small differences on the individual plantations.
6. The ratio of the number of trees dead and discolored (infected) to the total number of trees dead or missing in 1967 is presented to reflect the relative seriousness of the disease on the individual plantations. However, this is converted to per cent for each age class in Table V.

In view of the manner in which the plantations and plots were chosen, the data reflect the increase in disease severity on infected portions of infected plantations. The study provides an estimate of what occurs once the disease is present, and is not designed to indicate spread in the geographic sense.

The results presented here are from one season of observation only. According to Skilling*, the winter of 1966-67 was a mild one in terms of pine mortality from Scleroderris canker, as compared to the previous winter (personal communication). Therefore, the mortality may have been less than average. Moreover, infected plantations may show a sudden and serious increase in mortality after a few years (Skilling, unpublished data).

Table V shows that the average incidence of new infection is 5.3% in the 7-10 year age group compared to 1.7% in the 4-6 year age group. Analysis for Student's "t" test indicates that the difference is significant at the 5% level (even when the plots of plantation 108b on the Washburn District - which exaggerate the difference-are excluded from the analysis). It could be assumed that the increased infection results from the build-up of inoculum within the plantations (as infected trees die and apothecia, or fruiting bodies, are produced and release ascospores into the air) as the stands grow older. However, few apothecia were found on any of the plots and, while the correlation between the number of dead and discolored trees found in 1966 and the increase in infection is strong in the 4-6 year age group (coeff. = .476 significant at the 1% level), it is not significant in the 7-10 year age group (coeff. = .160

*Darroll Skilling, Plant Pathologist, North Central Forest Experiment Station

when plantation 108b plots are included, coeff. = .279 when plantation 108b plots are excluded. Neither is significant at the 5% level). Apparently, other factors may account for the difference between the age groups.

The highest incidence of infection increase, the 28.2 per cent recorded on plantation 108b on the Washburn District, is due primarily to branch infections. How significant such infections are in terms of subsequent mortality is a question that cannot be answered at this time. Reportedly, at least some trees recover from branch infections - i.e., the fungus dies before it reaches the main stem.

About 30 per cent of the trees are "dead or missing". The main identified cause of mortality on the plots in 1967 was S. lagerbergii. The fungus apparently killed 40 per cent of the trees found dead on the plots in the 4-6 year age group and 56 per cent of those in the plots in the 7-10 year age group, or an average of 44% on all plots. However, the relative importance of the pathogen as a factor in the accumulated mortality is not known.

RECOMMENDATIONS

The evaluation has not been in progress long enough to offer recommendations to the land manager at this time.

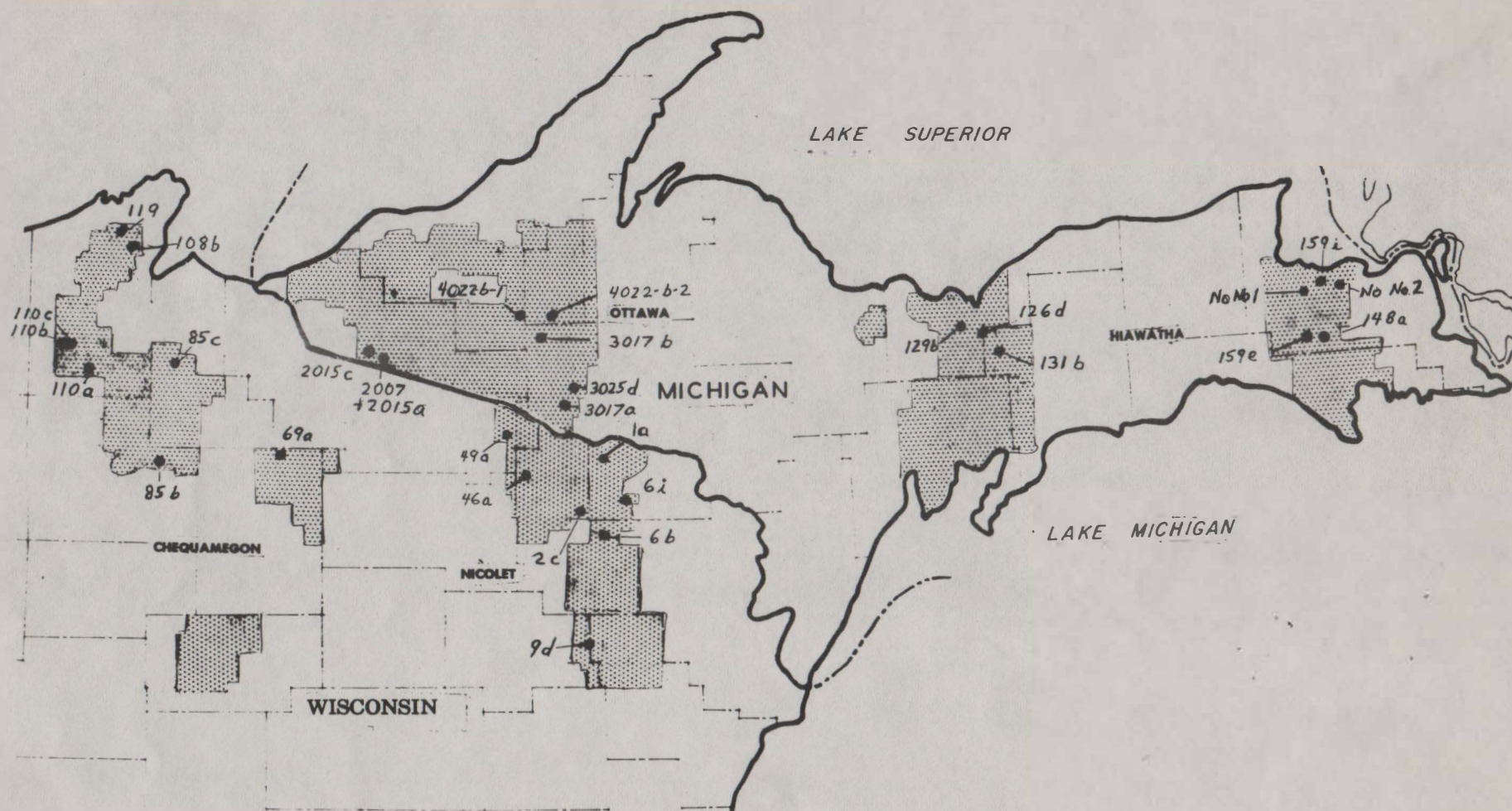


FIGURE I. APPROXIMATE LOCATIONS OF PLANTATIONS CONTAINING SCLERODERRIS CANKER SPREAD PLOTS.

TABLE I - RESULTS OF FIRST YEAR READINGS OF SCLERODERRIS SPREAD PLOTS

CHEQUAMEGON NATIONAL FOREST

District	Group	Plan- tation No.	No. Plots	Total Trees	Trees in- fected (Percent)		In- crease	Dead or Missing (Percent)		In- crease	Total dead & Discolored (Trees)		1967 Mortality: Ratio infected to Total
					1966	1967		1966	1967		1966	1967	
Washburn	7-10	108b	5	393	26.5	54.7	28.2	21.4 84	22.9 98	1.5	14	19	5:6 78%
		110a	5	333	7.5	9.3	1.8	30.3	31.8	1.5	15	20	5:5 100
		110b	5	280	7.8	8.9	1.1	38.6	38.9	0.3	8	9	1:1 100
		110c	5	283	10.9	15.5	4.6	34.3	36.0	1.7	12	16	4:5 80
		Total	20	1289	14.1	24.4	10.3	30.2	31.8	1.6	49	64	15:17
Glidden	4-6	85b	5	216	4.1	5.5	1.4	40.7	42.1	1.4	9	9	0:3 0
		85c	5	325	7.0	8.9	1.9	32.2	33.8	0.6	17	21	4:5 80
Washburn		119	5	306	6.8	8.8	2.0	32.4	38.6	6.2	22	27	5:19 2.5
Park Fs		69a	5	309	6.1	8.0	1.9	23.1	27.5	4.4	12	17	5:12 40%
		Total	20	1156	6.2	8.0	1.8	31.6	34.9	3.3	60	74	14:39
Forest Total			40	2445	10.3	16.6	6.3	30.9	33.2	2.3	109	138	29:56

TABLE II- RESULTS OF FIRST YEAR READINGS OF SCHLERODERRIS SPREAD PLOTS

NICOLET NATIONAL FOREST

District	Age Group	Plan- tation No.	No. Plots	Total Trees	Trees Infected (Percent)		Increase	Dead or Missing (Percent)		In- crease	Total Dead & Discolored (Trees)		1967 Mortality: Ratio Infected To Total
					1966	1967		1966	1967		1966	1967	
Florence	7-10	1-a	5	363	1.9	4.1	2.2	16.5	18.2	1.7	2	2	0:6
		2-c	5	445	0.6	0.8	0.2	14.6	15.5	0.9	2	2	0:4
		Total	10	808	1.2	2.4	1.2	15.5	16.7	1.2	4	4	0:10
Florence	4-6	6 i	5	442	3.3	4.2	0.9	29.2	32.1	2.9	7	11	4:13
Laona		6 b	5	258	3.4	3.8	0.4	32.9	36.8	3.9	7	8	1:10
Eagle Rv.		49 a	5	396	17.9	23.7	5.8	27.0	33.3	6.3	29	42	13:25
Three Lks.		46 a	5	400	4.5	5.8	1.3	28.5	39.2	10.7	10	18	8:43
Lakewood		9d	5	380	.3	.5	0.2	23.2	23.7	0.5	1	2	1:2
		Total	25	1876	6.1	7.9	1.8	28.7	32.8	4.1	54	81	27:93
Forest Total			35	2684	4.6	6.2	1.6	24.1	28.0	3.9	58	85	27:103

TABLE III - RESULTS OF FIRST YEAR READINGS OF SCHLERODERRIS SPREAD PLOTS

OTTAWA NATIONAL FOREST

District	Age Group	Plan- tation No.	No. Plots	Total Trees	Trees Infected (Percent)		In- crease	Dead or Missing (Percent)		In- crease	Total dead & Discolored (Trees)		1967 Mortality: Ratio infected to total
					1966	1967		1966	1967		1966	1967	
Iron Rv.	7-10	3017-b	4	277	10.1	13.0	2.9	31.8	33.6	1.8	13	16	3:5
		3017-a	4	192	6.8	8.8	2.0	30.2	33.3	3.1	6	8	2:6
	Bessemer	2007	5	223	14.4	16.6	2.2	18.4	21.1	2.7	8	9	1:6
		Total	13	692	10.5	13.0	2.5	27.0	29.5	2.5	27	33	6:17
Bessemer	4-6	2015-a	4	244	6.9	7.7	0.8	21.7	23.4	1.7	11	11	0:4
		2015-c	5	269	7.4	7.8	0.4	30.5	34.9	4.4	17	21	4:12
	Kenton	4022-b-2	5	313	4.4	6.0	1.6	12.5	16.9	4.4	6	9	3:14
		4022-b-1	5	368	18.4	20.3	1.9	21.5	27.4	5.9	28	49	21:22
	Iron Rv	3025-d	5	217	5.9	5.9	0.0	18.9	22.6	3.7	10	13	3:8
		Total	24	1411	9.3	10.4	1.1	20.8	25.1	4.3	72	103	31:60
Forest Total			37	2103	9.7	11.2	1.5	22.9	26.5	3.6	97	136	37:77

TABLE IV - RESULTS OF FIRST YEAR READINGS OF SCHLERODERRIS SPREAD PLOTS

HIAWATHA NATIONAL FOREST														
District	Age Group	Plan-tation No.	No. Plots	Total Trees	Trees Infected (Percent)		Increase	Dead or Missing (Percent)		In-crease	Total Dead & Discolored (Trees)		1967 Mortality: Ratio infected to Total	
					1966	1967		1966	1967		1966	1967		
Munising	7-10	126d-1	5	360	32.5	38.6	6.1	45.8	51.7	5.9	44	61	17:21	
		129-b	5	353	27.8	36.0	8.2	17.8	19.0	1.2	13	17	4:4	
		131-b	5	328	9.8	11.0	1.2	29.0	31.4	2.4	11	11	0:8	
Soo		148-a	5	402	9.7	12.4	2.7	23.6	30.8	2.2	11	17	6:9	
		Total	20	1443	19.8	24.4	4.6	30.4	33.3	2.9	79	106	27:42	
Soo	4-6	159-i	5	361	6.0	9.9	3.9	28.2	30.7	2.5	13	20	7:9	
		No No.1	5	296	3.7	6.4	2.7	27.4	29.0	1.6	3	6	3:5	
		No No.2	5	353	7.0	9.0	2.0	36.5	41.6	5.1	14	20	6:18	
		159-e	5	367	3.2	3.5	0.3	20.2	21.2	1.0	6	8	2:4	
		Total	20	1377	5.1	7.3	2.2	28.0	30.6	2.6	36	54	18:36	
Forest Total				40	2820	12.6	16.0	3.4	29.2	32.0	2.8	115	160	45:78

TABLE V. - RESULTS OF FIRST YEAR READING OF SCLERODERRIS SPREAD PLOTS

SUMMARY ALL FORESTS

Age Group	No. Plots	Total Trees	Infected (Percent)		Increase	Dead or Missing (Percent)		Increase	Total Dead and Discolored		Mort. Ratio Infected To Tot.	Percent 1967 Mortality Due to S.I.
			1966	1967		1966	1967		1966	1967		
7-10	63	4232	13.0	18.3	5.3	26.9	29.0	2.1	159	207	48:86	55.8*
4-6	89	5820	6.7	8.4	1.7	26.9	30.9	4.0	222	312	90:228	39.5**
Total	152	10052	9.3	12.6	3.3	26.9	30.1	3.2	381	519	138:314	44.0 ***
<p>* i.e. Increase in dead or missing due to <i>S. lagerbergii</i> = 1.1%</p> <p>** i.e. Increase in dead or missing due to <i>S. lagerbergii</i> = 1.5%</p> <p>*** i.e. Increase in dead or missing due to <i>S. lagerbergii</i> = 1.4%</p>												

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